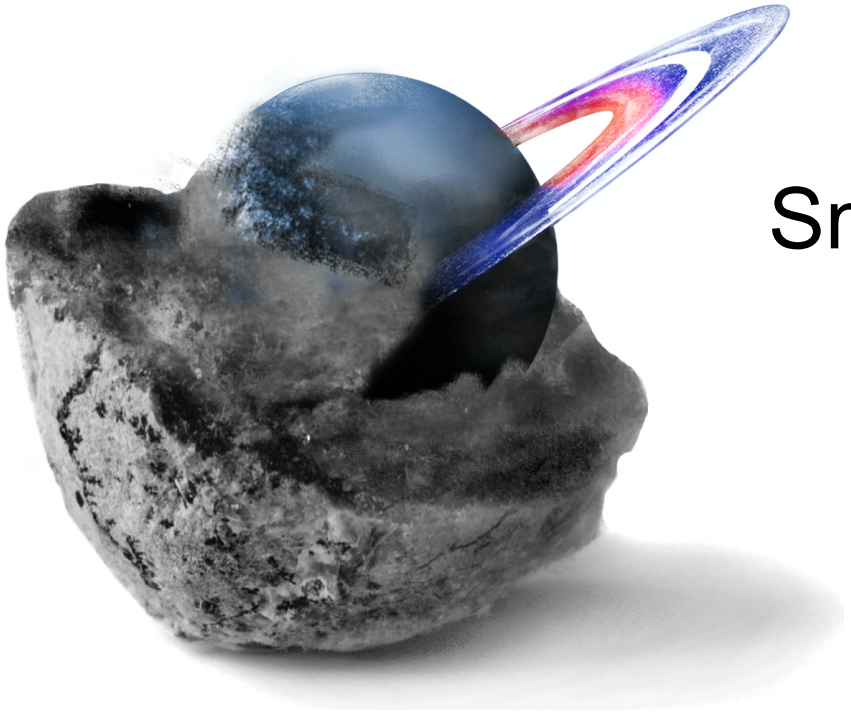

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How JPL Formulates SmallSat Missions Using A-Team and Team X_c

2018 Smallsat Conference
Logan, Utah

Steve Matousek, Advanced Concept Methods Manager
Annie Marinan, Team Xc lead

Jet Propulsion Laboratory, California Institute of Technology

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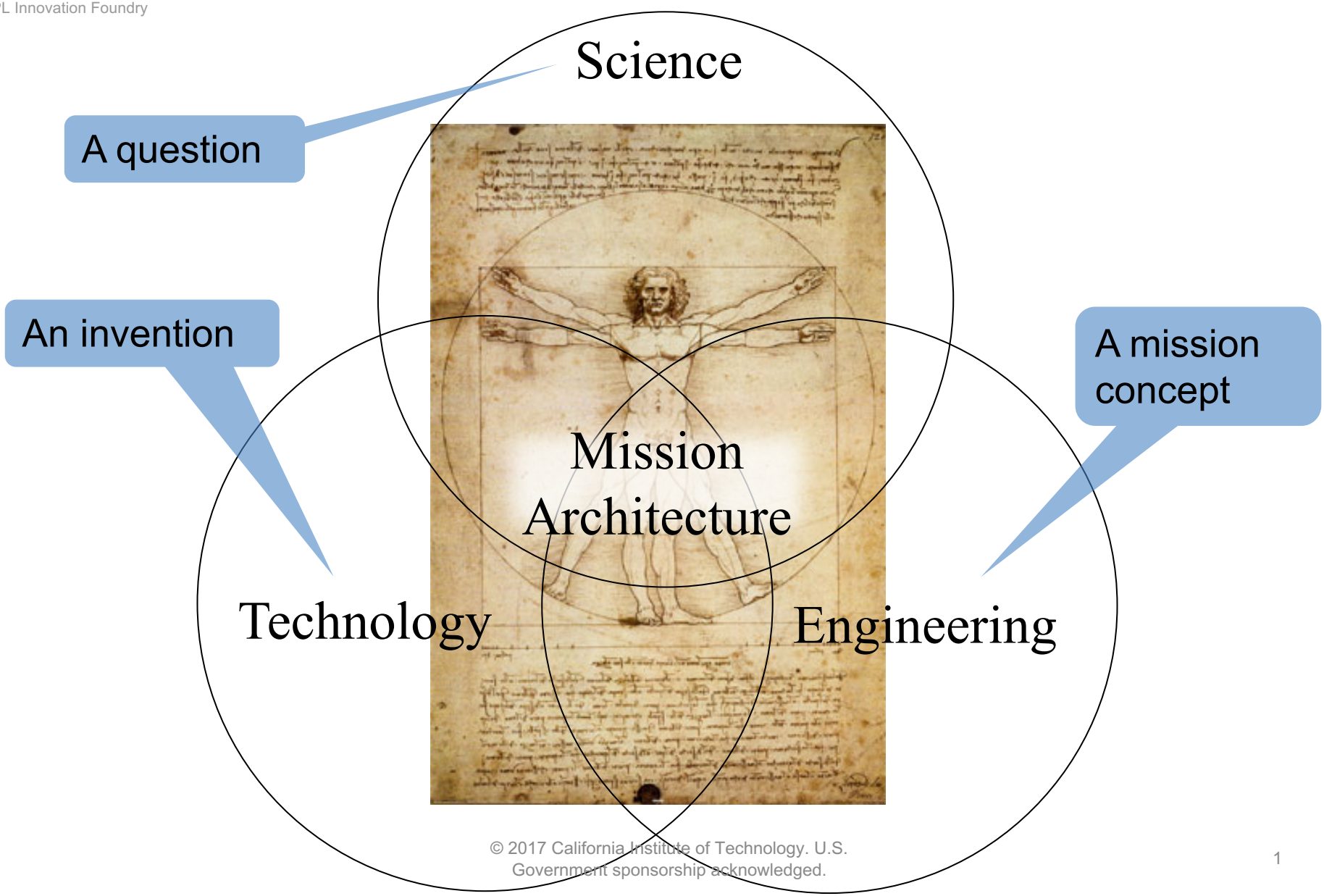
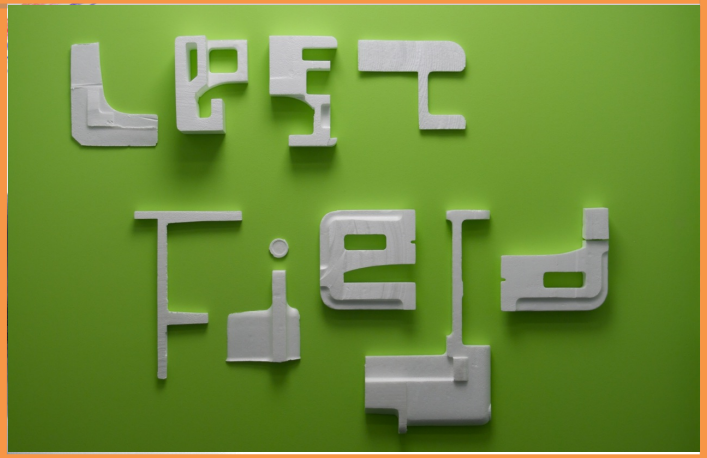
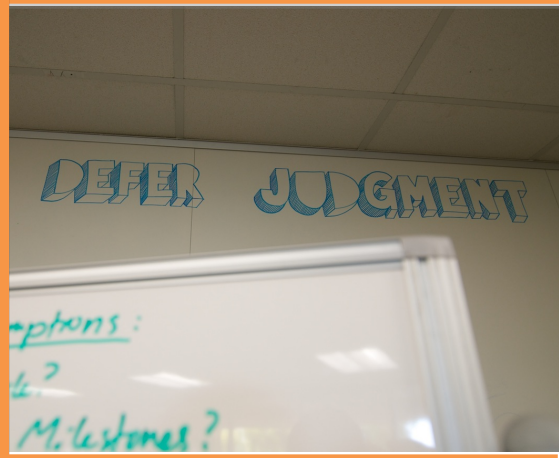
Every mission starts with a spark




F=ma


Client Supplied Materials
Archive


LEFT
FIELD


DEFER JUDGMENT


F=ma

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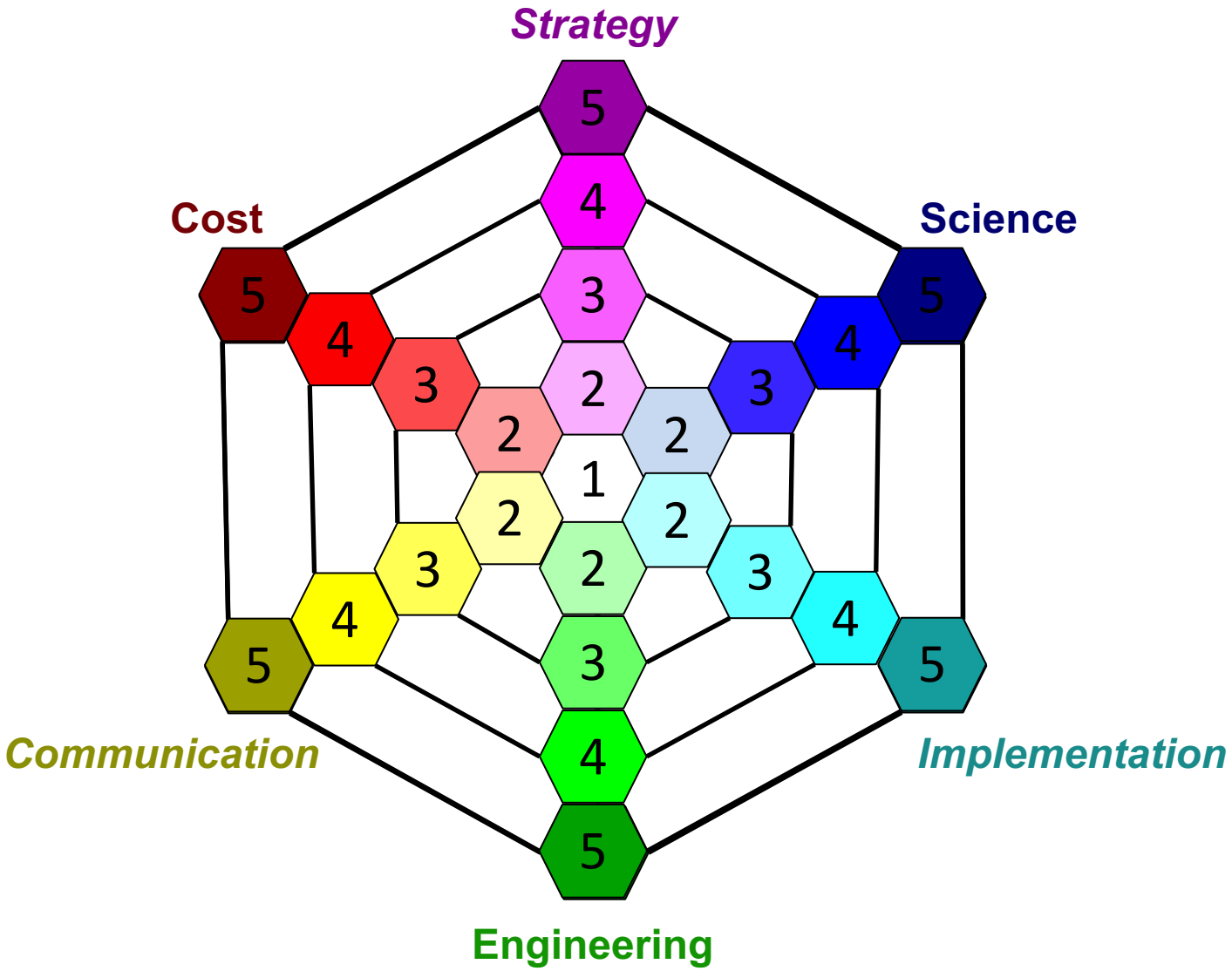
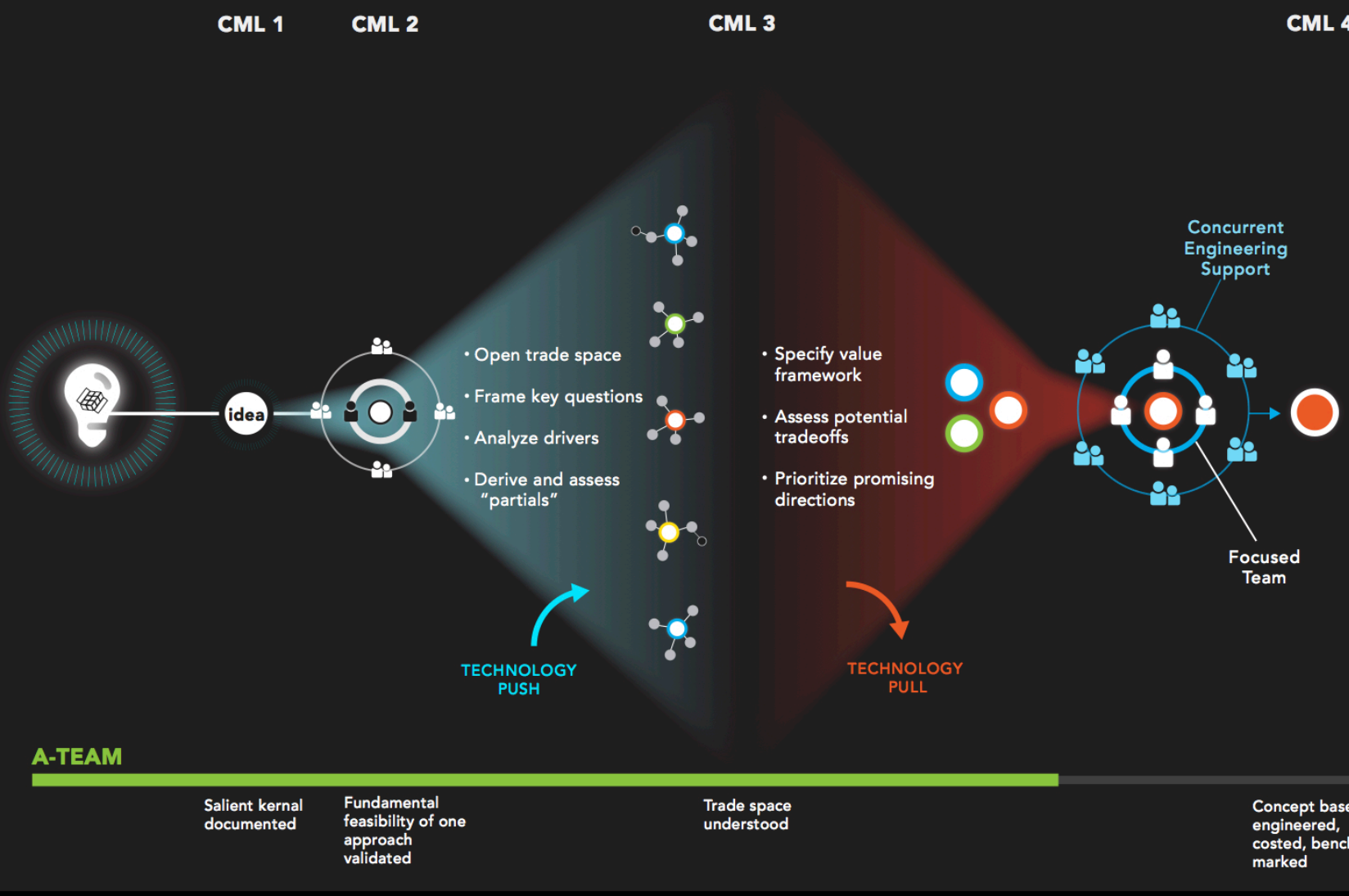
Mature Concept is Self-Consistent in All 6 Dimensions of the Concept Maturity Level (CML)




CML 1
CML 2
CML 3
CML 4
idea
• Open trade space
• Frame key questions
• Analyze drivers
• Derive and assess "partials"
TECHNOLOGY PUSH
• Specify value framework
• Assess potential tradeoffs
• Prioritize promising directions
TECHNOLOGY PULL
Concurrent Engineering Support
Focused Team
A-TEAM
Salient kernal documented
Fundamental feasibility of one approach validated
Trade space understood
Concept baseline engineered, costed, bench-marked
LEGEND:
IDEA
CONCEPT PROTOTYPE
POINT DESIGN

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The A-Team

A guided conversation with set objectives and proven methods

An early focal point for concept teams to build and mature ideas

A network of experts, leaders, and innovators

A center for intellectual honesty and exploration

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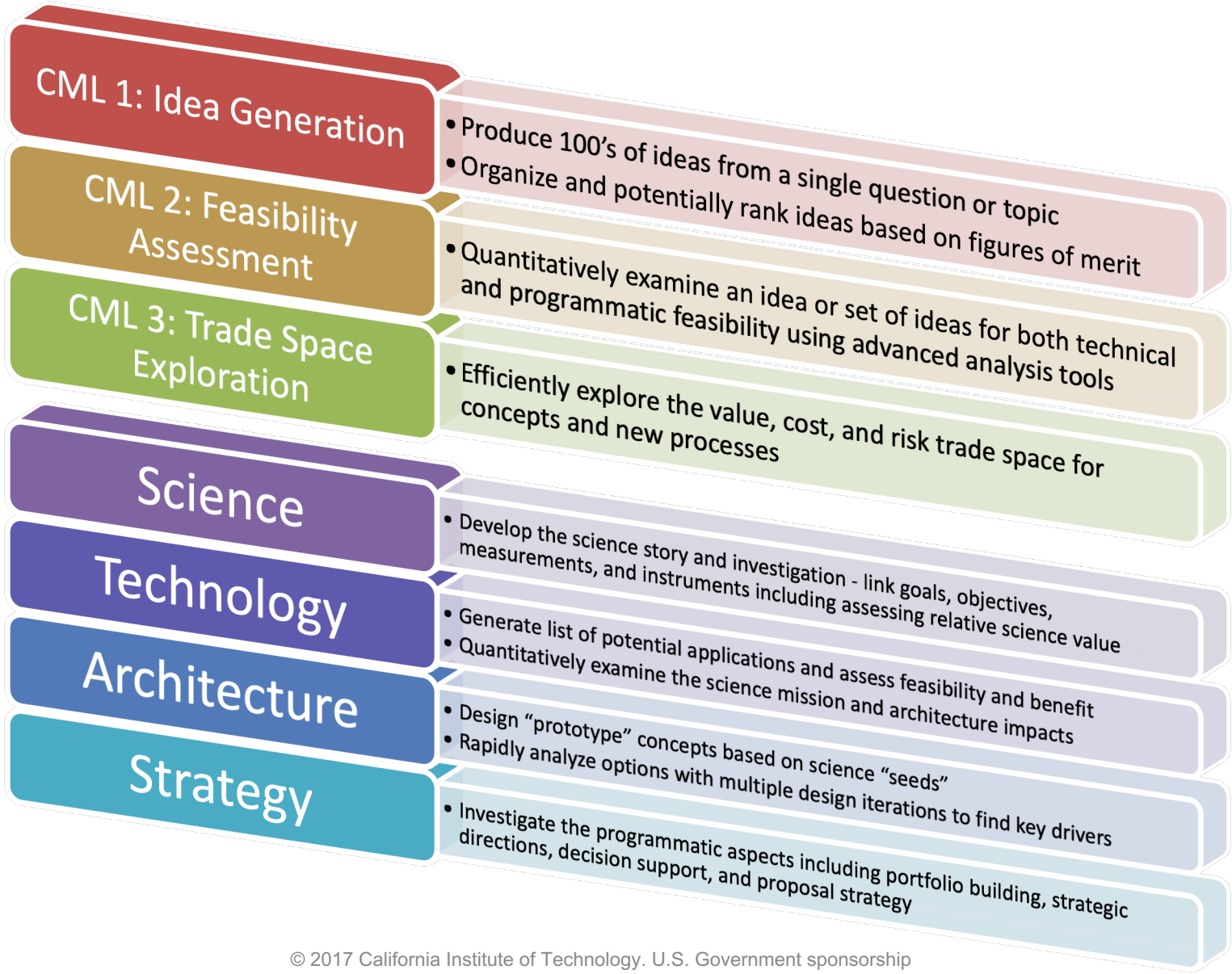
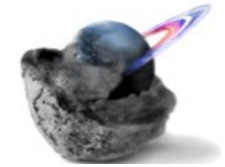
A-Team Study Types





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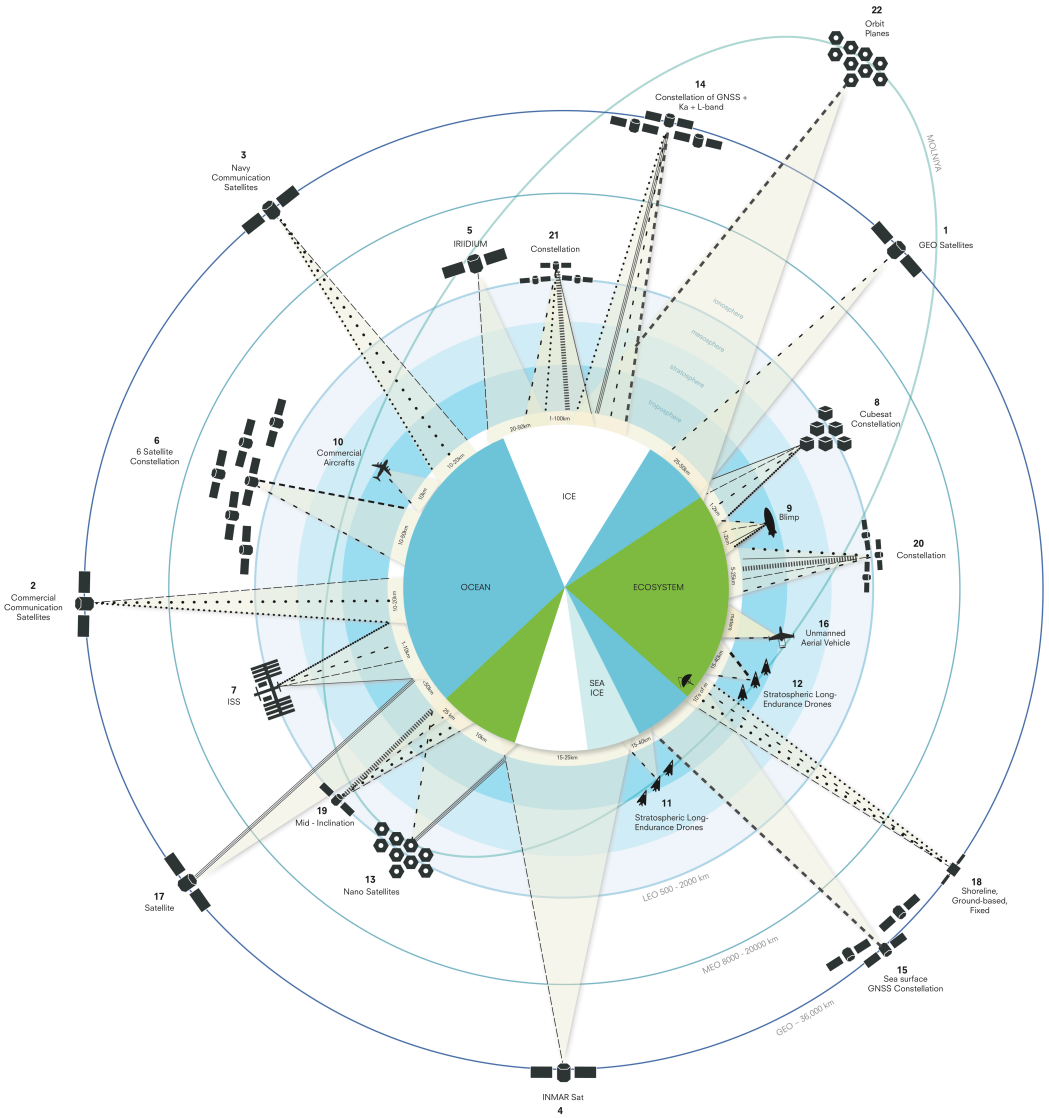
Design Thinking and Visual Strategy

PLATFORM

1 GEO SATELLITES
2 COMMERCIAL COMM SATELITTES
3 NAVY COMM SATELLITES
4 INMAR SAT
5 IRIDIUM
6 STATIONARY SITE
7 SATELLITE CONSTELLATION
8 ISS
9 CUBESAT CONSTELLATION
10 COMMERCIAL AIRCRAFTS
11 STRATOSPHERIC LONG-ENDURANCE DRONES
12 STRATOSPHERIC LONG-ENDURANCE DRONES
13 NANOSATELLITES
14 CONSTELLATION OF GNSS+Ka+L-BAND
15 SEA SURFACE GNSS CONSTELLATION
16 UNMANNED AERIAL VEHICLE
17 SATELLITE
18 SHORELINE, GROUND-BASED, FIXED
19 MID-INCLINATION
20 LEO CONSTELLATION
21 LEO CONSTELLATION
22 ORBIT PLANES

WAVELENGTHS

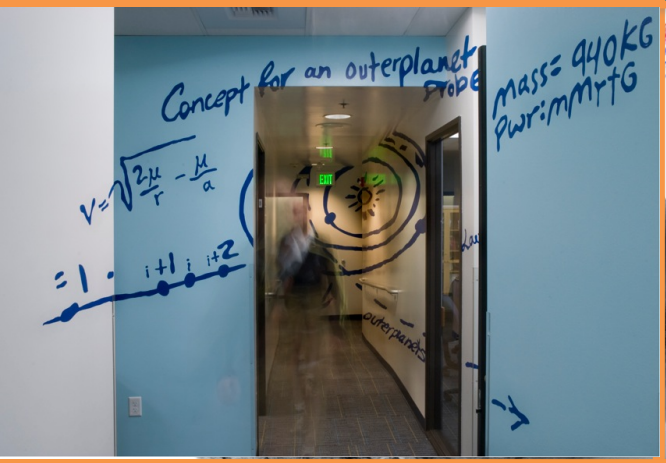
K-band
Ka-band
Ku-band
L-band
S-band
X-band
C-band
GNSS
Multiple



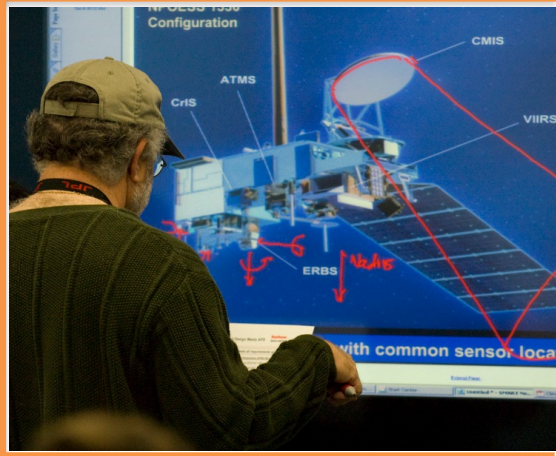
ICONS

Satellites
Cubesats
Nanosats
Drones
International Space Station
Blimp
Commercial Aircraft
Unmanned Aerial Vehicle
Direct Broadcast Dish
Public and Private Satellites

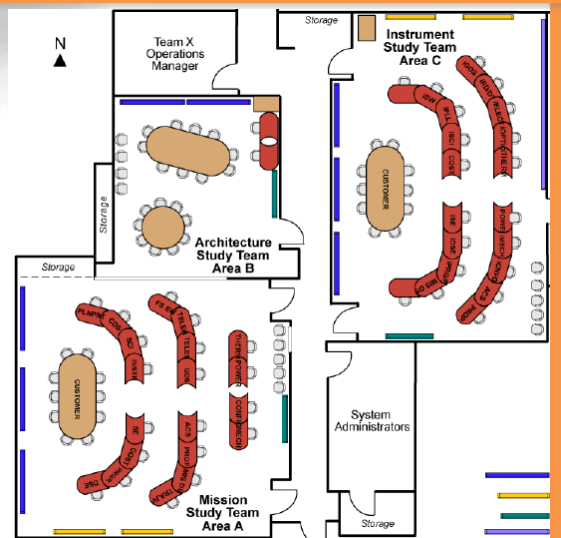

active
corpus
callosum

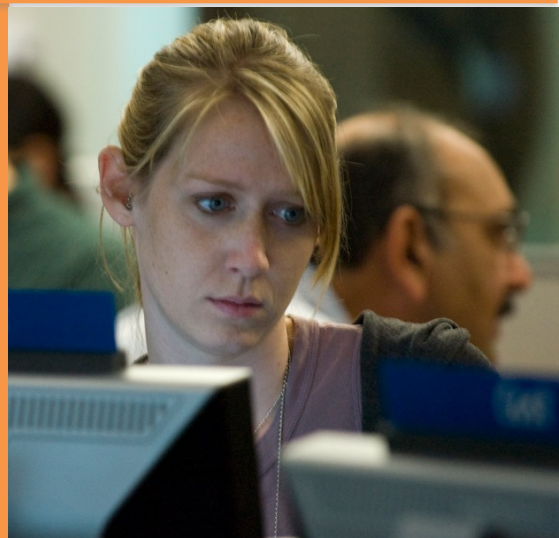

Concept for an outerplanet Probe
mass= 940KG
Pwr:mMrTG
EXIT


TEAM X
Jet Propulsion Laboratory


Configuration
CMIS
ATMS
CrIS
VIIRS
ERBS


TEAM X


N
Team X Operations Manager
Storage
Instrument Study Team Area C
Architecture Study Team Area B
Storage
Storage
CUSTOMER
System Administrators
Mission Study Team Area A
Storage



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>>10^3 Team X Studies

Team X is a concurrent engineering team for rapid design and analysis of novel space mission concepts

- Backed by refined and validated, institutionally supported, integrated tools, models, and processes
- Staffed and backed by doing organizations
- Well-suited for all aspects of Pre-Phase A and Phase A design activities

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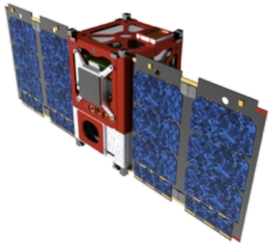
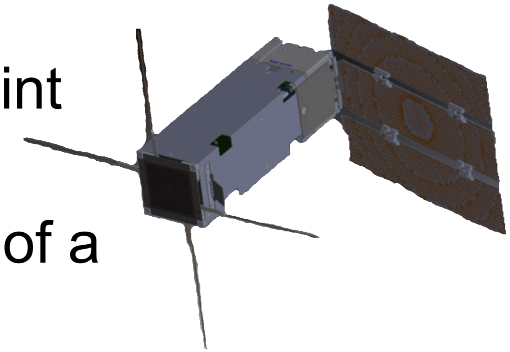
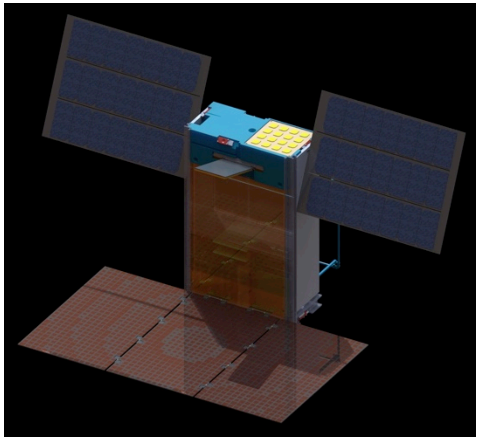
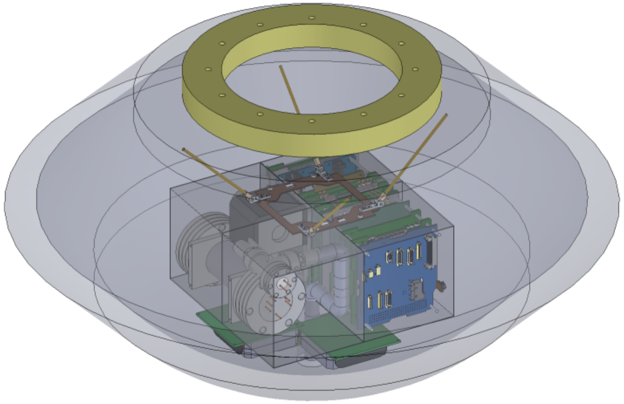
Team Xc – Fast Formulation



- Agile, collaborative design team built on Team X infrastructure
  - Fast turnaround for CubeSat/Smallsat mission concepts and studies
  - Quickly assess feasibility, trade space, point designs, ops concept
  - Product can include 3-D printout ➔ more of a design than a concept



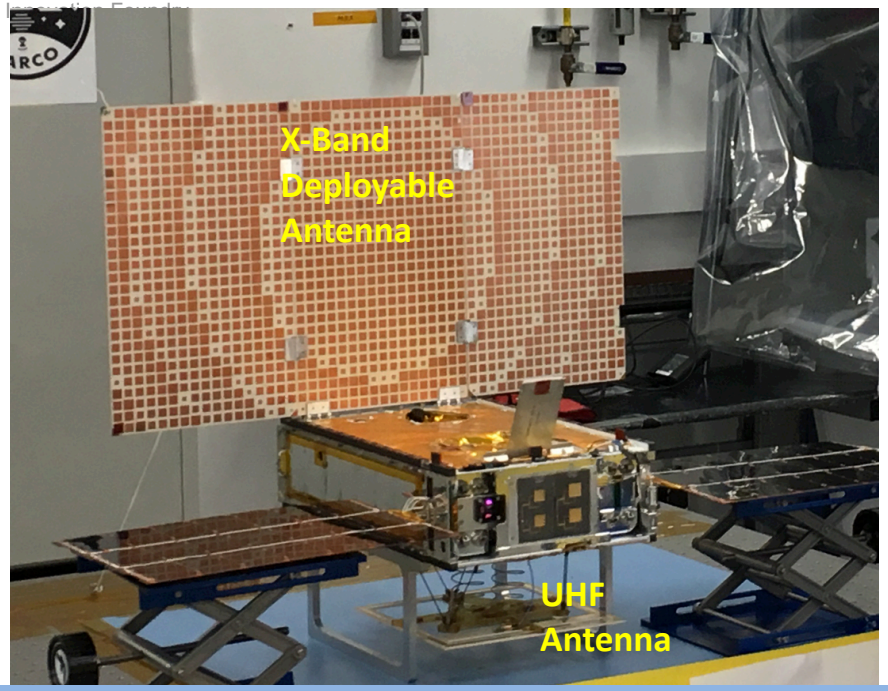




Mars Cube One

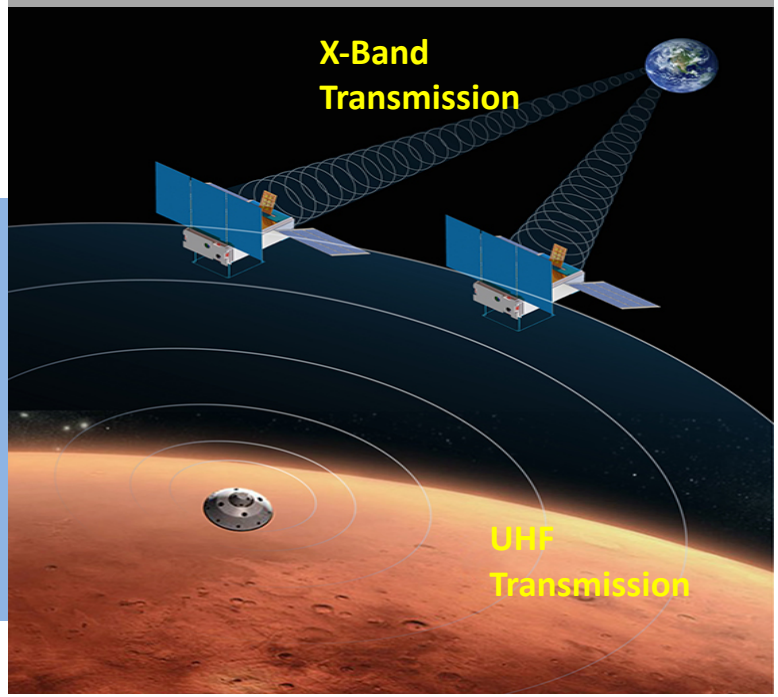
First Planetary CubeSat Mission

MarCO

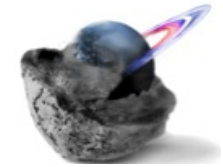


A Technology Demonstration of communications relay system for Mars missions' critical events such as the 2018 InSight entry, descent, & landing.

Interplanetary Travel
Flyby Mars



- **Two redundant 6U CubeSat spacecraft**
- **Launch: May 2018; Arrival: Dec. 2018**
- **Real-time relay of InSight EDL data**
  - **UHF link: InSight lander to MarCO**
  - **X-band link: MarCO to Earth**



JPL's Innovation Foundry

jplfoundry.jpl.nasa.gov